Does Specialty Certification or Hospital Practice Environment Influence the Choice Between Regional or General Anaesthesia for Cesarean Section?

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By D. Johnson and C. Truman

Purpose

To describe the use of regional anaesthesia (epidural or spinal technique) or general anaesthesia for cesarean sections in Alberta.

Approach

Physician claims and hospital abstracts, between April 1, 1998 to March 31, 2000, were examined to determine the use of different anaesthesia techniques.

The literature favors the use of regional anaesthesia compared to general anaesthesia for cesarean sections as studies demonstrate fewer maternal and neonatal complications, improved maternal satisfaction, and no difference in neonatal complications. This study explored the influence of specific hospital characteristics (total volume of deliveries, geographic location, presence of an epidural anesthesia provider during labor) and type of physician (anaesthesiologist or family/general practitioner) on the use of regional or general anaesthesia.

Key findings

The following are key findings of this study:

- Hospital abstracts for 13,884 cesarean sections were analyzed. Anaesthetic use was as follows: epidural (thirty-three percent), spinal (forty-five percent), and general (twenty-two percent).
- Anaesthesiologists performed seventy-six percent of all anaesthetics.
- General/family practitioners used general anaesthetia for thirty-eight percent of their cesarean sections while anaesthesiologists used general anaesthetic for seventeen percent of cases.
- Within regional and metropolitan hospitals, the percent of general anaesthesia used by anaesthesiologists ranged from five to fifty percent.
- After adjusting for other factors, the following factors were associated with lower use of general anaesthesia for cesarean sections:
  - hospitals with more epidural procedure providers for labour
  - larger, regional and metropolitan hospitals
  - hospitals with a high volume epidural procedure provider on staff
  - use of anaesthesiologists

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Conclusions

While the overall use of regional anaesthesia for cesarean sections in Alberta is high, the chance of receiving a general anaesthetic for a cesarean section varies across the province. Administrators or professional associations wishing to enhance the use of regional anaesthesia for cesarean sections must be aware of the practice conditions that favour the use of regional anaesthesia. This study suggests that given the current practice environment such a change would require sufficient volume of cesarean sections and support for providers that "specialize" in the use of regional anaesthesia.

For more information

Copies of the report are available from the ***Alberta Centre for Health Services Utilization Research***

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Alberta Centre for Health Services Utilization Research

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TABLE OF CONTENTS

Summary 1
Introduction 2
Methods 3
Results 4
Discussion 6
Limitations 7
References 8
Table 1: Type of anaesthetic for cesarean section by facility type and involvement of anaesthesiologist 10
Figure 1: Percent general anaesthetics for cesarean sections in Alberta hospitals grouped by number of deliveries and geographic location 11
Figure 2: Percent general anaesthetics by anaesthesiologists for cesarean sections 12
Table 2: Description of stepwise logistic regression explanatory factors for use of general anaesthesia during cesarean section 13
Appendix 14
Table: Description of anaesthetic techniques by service health region 14
Biographies 15
David Johnson, M.D. 15
Corrine Truman, R.N., Ph.D. 16

SUMMARY

The overall use of general anaesthesia for cesarean sections in Alberta occurs in only twenty-two percent of patients. This percentage compares favourably to that described in other North American and European countries. However, for the individual patient, the chance of receiving a general anaesthetic during a cesarean section varies dramatically between individual hospitals. This practice variation is noted between smaller rural and larger rural hospitals, between regional and metropolitan hospitals, between metropolitan hospitals in Edmonton, between Calgary and Edmonton hospitals, between family/general practitioners and anaesthesiologists, and between anaesthesiologists at various hospital sites. This data would be consistent with the view that on balance, the choice between regional and general anaesthesia for cesarean section is neutral. If, however, regional anaesthesia is preferred, then this message has been received with varying penetration in Alberta hospitals. For example, differences of more than twenty percent exist in the use of regional anaesthesia by anaesthesiologists comparing hospitals with a high volume of cesarean sections located in close proximity within one metropolitan centre. Administrators or professional associations wishing to enhance the use of regional anaesthesia for cesarean sections must be aware of the practice conditions that favour the use of regional anaesthesia. Our study suggests given the current practice environment, such a change would require sufficient hospital volume of cesarean sections and support for providers that "specialize" in the use of regional anaesthesia.

INTRODUCTION

Regional or general techniques can be used to provide anaesthesia for cesarean sections. The choice of technique can be influenced by a variety of considerations including patient and physician preferences, anticipated time required for induction of anaesthesia, or anatomical restrictions [1]. There is insufficient evidence to determine the relative risk of general versus regional anaesthesia for cesarean section [2], however the literature suggests that more maternal deaths are associated with general anaesthesia [3-5]. As well, when comparing general to regional anaesthesia, a larger proportion of newborns after general anaesthesia have Apgars less than seven at one and five minutes [6]. If appropriate physician and nursing staff are available, regional anaesthesia by epidural or spinal technique should be an option offered by every hospital providing delivery services [7]. Although there is a world-wide shift in obstetrical anaesthetic practice in favor of regional techniques, considerable variation exists comparing national level practices within the last five years. The use of regional anaesthesia is over seventy percent in United Kingdom training units [8], approximately fifty percent in New South Wales [9], forty-eight percent in France [10] but used in only twenty-five percent of cesarean sections in Germany [11]. This medical practice variation may in part be the result of local organization and practice culture which influence physicians' choices about the care they provide [12].

Using administrative databases, we assess the influence of physician training (anaesthesia specialist versus family and general practice) upon the use of regional or general anaesthesia for cesarean section. The practice site influence (hospital volume of deliveries, rural/regional/metropolitan location, number of physicians providing anaesthesia for cesarean section at each hospital, number of physicians providing epidural analgesia for maternal deliveries at each hospital, and presence of a high volume regional anaesthesia physician for maternal labour) is assessed.

METHODS

Two administrative health service databases were used:

1. Canadian Institute for Health Information's (CIHI) Inpatient Discharge Abstract Database (DAD) for the province of Alberta for 1998/99 and 1999/00,
2. Alberta Physician Claims Assessment System Database for 1998/99 and 1999/00.

All data was accessed through Alberta Health and Wellness and the work was done in conjunction with a larger study being carried out by the Alberta Centre for Health Services Utilization Research.

Maternal deliveries were identified using the Canadian Institute for Health Information's Inpatient Discharge Abstract Database (CIHI DAD). Over ninety-nine percent of births that occur in Alberta every year take place in acute care facilities. All separations with main patient service area 51 (obstetrics delivered) for 1998/99 and 1999/00 were extracted for the last available two fiscal years. The decision to combine two years of data was made because the volume of deliveries in some facilities was low. No stillbirths were included.

Cesarean sections (ICD-9-CM 74.0, 74.1, 74.2, 74.4, & 74.9) was identified in any of the ten CIHI DAD procedural codes fields. Type of anaesthesia (none, local, epidural, spinal, and general) was extracted as a linked variable corresponding with a cesarean section procedure. The physician performing the anaesthetic service is not uniquely identified in the CIHI DAD, so that this data required a link to physician claims.

Physician claims were extracted for identified maternal deliveries using the Canadian Classification of Procedures (CCPx) code. The anonymous maternal identifier for delivery hospital separations was used to identify specific anaesthetic billing records. In this manner, the unique physician providing the service and specialty (family/general practice, anaesthesiologist) certification recognized by the Alberta College of Physicians was obtained. Physician claims for anaesthesia do not specify the technique employed (i.e. regional or general). Billing records do include claims for epidural anaesthesia (CCPx 16.91C) provided during labour. The presence of an anaesthetic claim for epidural anaesthesia prior to the

cesarean section was linked to the maternal delivery record. In this manner, the use of epidural analgesia during labour was determined. The number of unique physicians that claimed for epidural analgesia at each hospital during the two study years was calculated. The presence of at least one physician that provided high volume of epidural procedures during labour at each hospital was determined. High volume was defined as a physician that performed more than the 99th percentile (i.e. more than 150 per year) epidural procedures during the two study years.

Facilities providing maternal delivery services were categorized by the average number of deliveries per year over a three-year period (1997/98, 1998/99, and 1999/00) and their geographic location; 1) rural-small (1 to 49 deliveries per year); 2) rural-medium (50 to 99 deliveries per year); 3) rural-large (100 to 405 deliveries per year); 4) regional (631 to 1,691 deliveries per year in one of the five non-metropolitan regional Alberta hospitals); 5) metropolitan (any hospital located in the metropolitan health regions of Calgary or Edmonton); 6) metropolitan-NICU (two metropolitan hospitals with level three neonatal intensive care units).

Statistical modelling was done using stepwise logistic regression. The order of factor entry into the model is an estimate of the factors relative explanatory strength. The dependent variable was use of general anaesthesia (i.e. yes, no) for cesarean section. General anaesthetics, which were preceded by epidural analgesia during labour, were eliminated from this analysis as the intent to use regional anaesthesia may have been overridden by other clinical priorities. The influencing factors in the regression were facility group as described above, anaesthetic performed by anaesthesiologist, number of unique physicians that performed at least one anaesthetic for cesarean sections at each hospital site during the study period, number of unique physicians that perform an epidural procedure for labour at each site during the study period, and high volume epidural analgesia provider. Significance was defined as $p < 0.05$.

RESULTS

Hospital abstracts of 13,884 cesarean sections in Alberta during April 1, 1998 to March 31, 2000 were analysed. An anaesthetic type was identified in all but ten cases. Overall, the technique for anaesthesia employed was epidural (33 percent), spinal (45 percent), and general anaesthesia (22 percent). Of the 3,011 general anaesthetics, 358 (12 percent) had a previous epidural procedure for labour.

Anaesthesiologists performed 76 percent of the anaesthetics for cesarean sections and general/family practitioners delivered the remainder. The median number of anaesthetic providers for cesarean sections at each facility was 6 (range 1 to 77). The median number of epidural providers for labour at each facility was 3 (range 1 to 73). High volume epidural providers were located at one hospital in Calgary and one hospital in Edmonton.

Table 1 demonstrates the anaesthetic type by facility group. Only in regional hospitals did both anaesthesiologists and family practitioners perform significant proportions of anaesthetic procedures. Thirty-eight percent of anaesthetics performed by general/family practitioners were general anaesthesia and seventeen percent of anaesthetics performed by anaesthesiologists were general anaesthesia (chi square $p < 0.000$). In regional hospitals, forty percent of 777 anaesthetics performed by general/family practitioners were general anaesthesia and thirty-three percent of 1,396 anaesthetics performed by anaesthesiologists were general anaesthesia (chi square $p < 0.001$).

Figure 1 plots the plots the overall percentage of general anaesthetics given during cesarean sections for each hospital in Alberta. Hospitals are grouped by the number of deliveries for each facility with increasing number of deliveries and more urban centres plotted from right to left. As some sites performed few cesarean sections, the type of anaesthetic percentage would change dramatically if only a few anaesthetics were or were not a general anaesthetic. The Spearman correlation between number of cesarean sections per hospital and percent general anaesthetics for cesarean sections is poor (0.15; $p = 0.31$).

Figure 2 plots the percentage of general anaesthetics given during cesarean sections for only those cesarean sections in which an anaesthesiologist was involved. As some hospital sites perform few cesarean sections and anaesthesiologists provide few services to smaller hospitals, only data from regional and metropolitan hospitals are shown. The percent of general anaesthetic for cesarean section varied between five percent to fifty percent (chi square $p<0.000$) between hospital sites. The Spearman correlation coefficient between number of cesarean sections per hospital site and the percentage of general anaesthesia done by anaesthesiologists for cesarean sections was 0.62 ($p = 0.043$).

Table 2 describes the logistic regression modeling results for provision of general anaesthesia rather than regional anaesthesia for cesarean sections. The factors relative influence is ordered from top to bottom. Hospitals with more epidural procedure providers during labour were three percent less

likely to have providers choose general anaesthesia for cesarean sections. Compared to the smallest hospitals (less than 50 deliveries per year in a rural hospital), larger rural hospitals with 100 to 405 deliveries per year (2.1 times), regional hospitals (2.6 times), metropolitan Edmonton hospitals (4.3 times), and metropolitan Calgary hospitals (9.1 times) were less likely to have providers choose general anaesthesia for cesarean sections. Hospitals with a high volume epidural procedure provider during labour were sixty-four percent less likely to have providers choose general anaesthesia for cesarean sections. Anaesthesiologists were thirty-two percent less likely to choose general anaesthesia for cesarean sections. Hospitals with more anaesthesia providers for cesarean sections were two percent more likely to have providers choose general anaesthesia for cesarean sections.

DISCUSSION

The practice environment plays a significant role in the decision between regional and general anaesthesia for cesarean section. The number of epidural procedure providers and a high volume epidural procedure provider decrease the use of general anaesthesia for cesarean section. A larger number of anaesthetists at any hospital increase the percentage of general anaesthetics for cesarean section. Speciality training was a weaker explanatory variable compared to number of deliveries at the hospital, location, and presence of epidural procedure providers. The presence of an anaesthesiologist at any one hospital does not ensure a uniform use of regional anaesthesia for cesarean section. Rather, the presence of peers that do regional anaesthesia during labour has a stronger association with the anaesthetic choice for cesarean section. Other researchers have noted that other practice parameters, such as, an on site anaesthesiologist at night, also influenced the rate of regional anaesthesia [10].

Over the last decade, obstetrical services have become more concentrated with fewer small, rural hospitals providing care [16-17]. Similar to our study, the use of regional anaesthesia increases with the number of births occurring at a specific hospital site [18, 19]. Anaesthesiologists are more likely to practice in larger hospitals. However, the use of general anaesthesia is only slightly different in larger, rural hospitals (thirty-nine percent) compared to regional hospitals (thirty-six percent), despite the virtual absence of anaesthesiologists in the larger rural hospitals and the predominance of anaesthetics performed by anaesthesiologists in regional hospitals (seventy-six percent). Hospital volume, more than provider speciality, favours the use

of regional anaesthesia. A local hospital champion also influences the use of regional anaesthesia.

The literature favours the use of regional anaesthesia compared to general anaesthesia for cesarean sections. Cohort studies demonstrate fewer maternal and neonatal complications, improved maternal satisfaction, and no increase in neonatal complications. A greater number of maternal deaths occur when general anaesthesia is administered for cesarean section [2-5,13-14]. A larger proportion of neonates in the general anaesthesia group compared to those in the regional anaesthesia group are assigned Apgar scores of less than seven at one and five minutes [6]. Some maternal side effects such as dural puncture headache are restricted to use of regional techniques. The literature is insufficient to examine the comparative merits of various regional anaesthetic techniques [13-14]. Few studies have utilized randomized comparisons of general versus regional anaesthesia resulting in potential selection bias in the reporting of outcomes. The advantage of randomized trials versus large cohort studies may be overestimated [15]. The limitations of a randomized trial to address this specific question include potential lack of generalizability and feasibility as well as the time and resources required. Large cohort studies may be sufficient to make an evidence based clinical recommendation.

LIMITATIONS

Family and general practice or anaesthesiologist identification relates to Alberta College of Physicians and Surgeons' classification. Family and general practice physicians may have specialist training not recognized by the Alberta College of Physicians and Surgeons. We were able to verify deliveries comparing two independent databases. We are reliant on those completing other data fields for non-verifiable data. Population-based administrative database research is highly generalizable although limited in clinical detail. For example, some regional anaesthesia may be counter-indicated because of anatomical considerations, bacteremia, or fetal distress [20]. The distribution of such patients cannot be assumed to be similar between hospitals. However, the magnitude difference in the use of regional anaesthesia for cesarean sections is so large, the differences in a small number of patients with absolute or relative contra-indications would likely be insufficient explanation.

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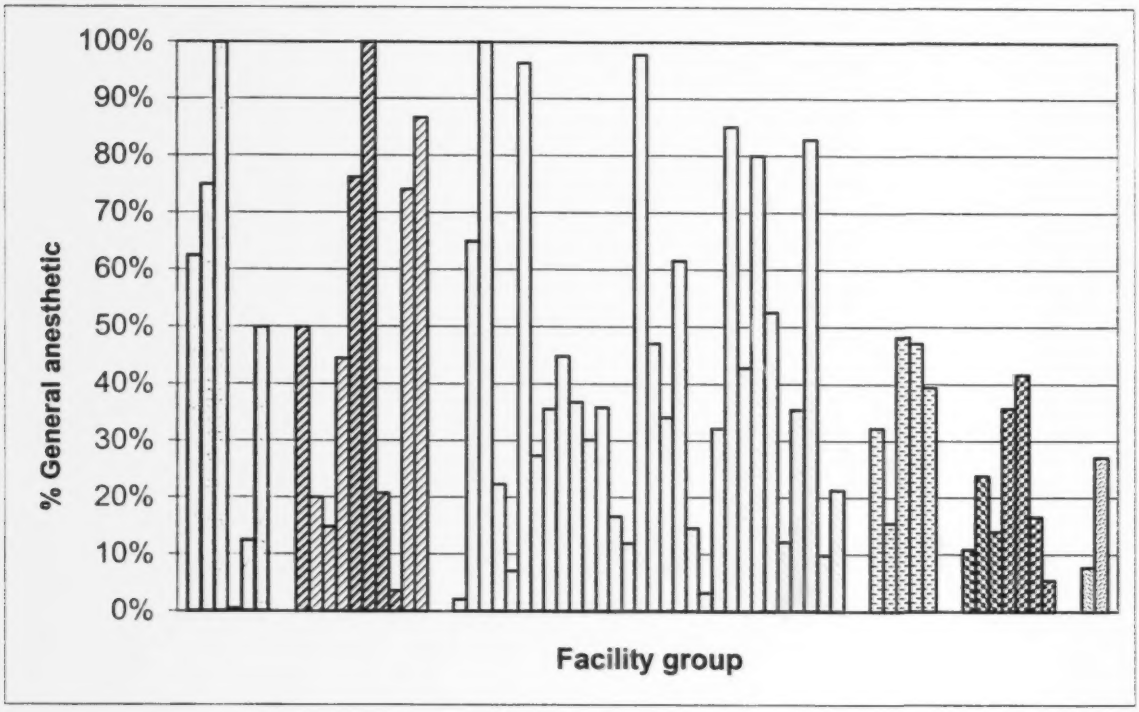
Table 1: Type of anaesthetic for cesarean section by facility type and involvement of anaesthesiologist

Facility Type	Epidural	Spinal	Regional (Epidural and Spinal)	General	Epidural and Subsequent General Anaesthetic	Procedure performed by anaesthesiologist
Rural-small (less than 50 deliveries per year)	10 (19%)	9 (17%)	19 (36%)	34 (64%)	0	1 (2%)
Rural-medium (50 – 99 deliveries per year)	26 (10%)	127 (50%)	153 (60%)	102 (40%)	11	2 (1%)
Rural-large (100 – 405 deliveries per year)	255 (15%)	785 (46%)	1,040 (61%)	669 (39%)	49	38 (2%)
Regional hospitals	394 (17%)	1,058 (47%)	1,452 (64%)	806 (36%)	79	1,399 (64%)
Metropolitan Calgary	2,408 (50%)	1,993 (42%)	4,401 (92%)	396 (8%)	36	4,603 (100%)
Metropolitan Edmonton	1,455 (31%)	2,196 (47%)	3,651 (78%)	1,004 (22%)	183	3,892 (86%)
Alberta	**4,548 (33%)**	**6,168 (45%)**	**10,716 (78%)**	**3,011 (22%)**	**358 (12%)**	**9,935 (76%)**

Where n is number of anaesthetics and bracketed number is percentage. Some cases not classified as anaesthetic type or facility identification not recorded.

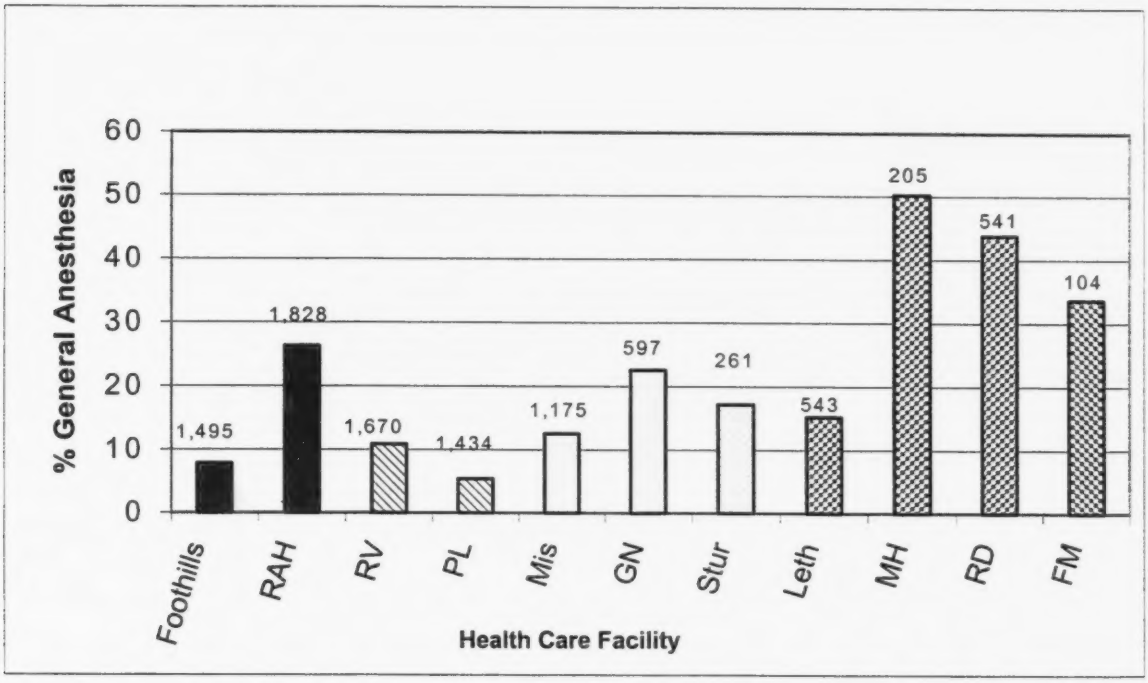
Figure 1: Percent general anaesthetics for cesarean sections in Alberta hospitals grouped by number of deliveries and geographic location



Where:

- Small rural hospitals with less than 50 deliveries per year
- Medium rural hospitals with 50 to 99 deliveries per year
- Large rural hospitals with 100 to 405 deliveries per year
- Regional hospitals
- metropolitan hospitals
- Referral metropolitan hospitals with level 3 neonatal intensive care unit

Figure 2: Percent general anaesthetics by anaesthesiologists for cesarean sections



Where:

- Metropolitan hospitals with level 3 neonatal intensive care units
- Metropolitan Calgary hospitals
- Metropolitan Edmonton hospitals
- Regional hospitals.

Number quoted is the number of cesarean sections performed at each hospital during the study period in which anaesthesiologist submitted a billing claim. When compared to Figure 2, one regional hospital and two hospitals surrounding a metropolitan area are not shown because of the low number of anaesthetics performed by anaesthesiologists.

Foothills is Calgary Foothills Hospital,
RAH is Royal Alexandra Hospital,
RV is Rocky View Hospital,
GN is Grey Nuns Hospital,
Mis is Misericordia Hospital,
PL is Peter Loughheed Hospital,
Stur is Sturgeon General Hospital,
Leth is Lethbridge Regional Hospital,
MH is Medicine Hat Regional Hospital,
RD is Red Deer Regional Hospital, and
FM is Fort McMurray General Hospital

Table 2: Description of stepwise logistic regression explanatory factors for use of general anaesthesia during cesarean section

Factors	Odds Ratio	95% Confidence Interval
Number of epidural procedure providers per hospital	0.97	(0.96 - 0.99)
Rural large hospital with 100 – 405 deliveries per year compared to hospitals with less than 50 deliveries per year*	0.48	(0.36 - 0.65)
Regional hospital compared hospitals with less than 50 deliveries per year*	0.39	(0.28 - 0.53)
Metropolitan Edmonton hospitals compared to hospitals less than 50 deliveries per year*	0.23	(0.14 - 0.37)
Metropolitan Calgary hospitals compared to hospitals with less than 50 deliveries per year*	0.11	(0.06 - 0.21)
High volume epidural procedure provider located at hospital	0.61	(0.51 - 0.71)
Anaesthesiologist performed anaesthetic**	0.76	(0.65 - 0.88)
Number of anaesthetic providers per hospital	1.02	(1.01 - 1.03)

* compared to small rural hospitals with less than fifty deliveries per year
** compared to general/family practice
Note: rank ordering of factors indicates relative strength of the factors' influence associated with the use of general anaesthesia for cesarean section.

APPENDIX

Table: Description of anaesthetic techniques by service health region

Service Health Region	Epidural Anaesthetic	Spinal Anaesthetic	General Anaesthetic	Epidural analgesia used with subsequent general anaesthesia	Procedures performed by anaesthesiologist
1	144 (20%)	375 (54%)	180 (26%)	28	562 (83%)
2	10 (3%)	106 (35%)	188 (62%)	4	209 (74%)
3	46 (25%)	112 (61%)	26 (14%)	5	3 (2%)
4	2,407 (50%)	1,987 (42%)	391 (8%)	36	4,602 (100%)
5	57 (45%)	5 (4%)	64 (51%)	3	0
6	134 (14%)	383 (41%)	413 (45%)	26	545 (60%)
7	48 (14%)	187 (54%)	111 (32%)	8	2 (1%)
8	31 (30%)	57 (54%)	17 (16%)	2	1 (1%)
9	7 (8%)	57 (67%)	21 (25%)	2	0
10	1,456 (31%)	2,202 (47%)	1,109 (22%)	183	3,893 (86%)
11	32 (25%)	29 (21%)	72 (54%)	9	4 (3%)
12	22 (6%)	209 (56%)	138 (37%)	8	4 (1%)
13	1 (0%)	289 (66%)	150 (34%)	6	4 (1%)
14	11 (8%)	62 (42%)	74 (50%)	2	1 (1%)
15	12 (14%)	26 (30%)	48 (56%)	0	0
16	129 (49%)	28 (11%)	103 (40%)	35	104 (43%)
17	1 (2%)	54 (89%)	6 (9%)	1	1 (7%)
Alberta	**4,548 (33%)**	**6,168 (45%)**	**3,011 (22%)**	**358 (12%)**	**9,935 (76%)**

This table demonstrates the type of anaesthetic for cesarean section aggregated by Alberta health service region. Some hospital sites perform few cesarean sections, so by aggregating into health regions, made aggregate estimates more robust. The percent of general anaesthetic for cesarean section varied between 8% to 56% ($p<0.000$) between service regions. The overall percent of general anaesthesia also varied between the two metropolitan regions (8% and 22% $p<0.000$).

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As a physician, Dr. Johnson's clinical practice is affected by the health care system. Dr. Johnson is interested in understanding and promoting the use of information in directing health policy formation and decision-making by the managers of the health care system.

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